REQUIREMENTS FOR GLASS FIBER REINFORCED CONCRETE (GFRC) PANELS

IR 19-2

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This interpretation is intended for use by the plan review and field engineers of DSA to indicate an acceptable method for achieving compliance with applicable codes and regulations. Its purpose is to promote more uniform statewide criteria for use in plan review and supervision of construction of public schools, community colleges and essential services buildings. Other methods proposed by design professionals to solve a particular problem may be considered by DSA and reviewed for code and regulation compliance.

Purpose: This IR provides guidelines for the acceptance of glass fiber reinforced concrete (GFRC) panels by the Division of the State Architect (DSA).

1. Definition. Glass fiber reinforced concrete is the term applied to products manufactured using a cement/aggregate slurry reinforced throughout with alkali-resistant glass fibers. GFRC is typically used in thin-walled architectural cladding panels with a minimum thickness of 1/2".

2. Product Description. Mix composition, degree of compaction, type of cement, and the proportion, length and orientation of glass fibers may all be varied to produce a specific product. Typically, a GFRC panel consists of 5% by weight (of total mix) alkali-resistant glass fiber (absolute minimum of 4%) combined with a portland cement/sand slurry (cement/sand ratio not less than 1:1 nor greater than 3:1). Panels are fabricated using a spray-up process. An alternate method of fabrication uses a GFRC premix, which consists of 3% to 4% by weight (of total mix) pre-chopped alkali-resistant glass fiber combined with a portland cement/sand slurry. Panels, utilizing the GFRC premix, are fabricated by placing the slurry into molds in a manner similar to precast concrete. Curing is provided with the use of a thermoplastic copolymer admixture, which retains moisture in the mix until adequately cured, or by moist curing. Admixtures such as water-reducers, accelerators, retarders and air-entraining agents may be used.

GFRC manufactured in accordance with the recommendations of the *PCI Recommended Practice for Glass Fiber Reinforced Concrete Panels*, 3rd Edition, has shown a history of good performance in resistance to weather and water penetration. A weather-resistive coating, however, is recommended over the GFRC panel, along with approved joint caulking compounds, to create a complete weather-resistive barrier.

3. Plant Fabrication and Quality Control Requirements of Precast GFRC Panels. The following requirements apply to all GFRC panels regardless of the fabrication process (spray-up or premix).

3.1 A testing and inspection program shall be provided by the design professional in responsible charge, shall be approved by DSA, and shall be referenced on the project Test and Inspection List. The program for the specific project shall require the testing and inspection provisions of the following sections.

3.2 GFRC panels shall be fabricated under the *PCI Recommended Practice for Glass Fiber Reinforced Concrete Panels*, 3rd Edition. The manufacturer shall have an established quality control program which meets the requirements of the *PCI Manual for Quality Control for Plants and Production of Glass Fiber Reinforced Concrete Products*, including the testing and inspection requirements of Part A, Division II, and utilizing the test procedures of Appendix F, except as noted below. Verification shall be provided by 1) a DSA review of the manufacturer's quality control manual, or 2) certification under the PCI Plant Certification Program. (A copy of the certificate shall be provided to DSA.)

3.2.1 The acceptance criteria for the Flex Anchor and Gravity Anchor Pull-off and Shear Tests, Part A, Division II, Section 2.1.5, Production Testing - After Curing is that the minimum ultimate strength at failure shall achieve three times the design load required by CBC,Section 1631A.2.4.2.5.

3.3 The manufacturing of the GFRC panels and the testing of the panels and connections shall be continuously inspected by a DSA approved independent inspection agency. The approved agency shall submit an affidavit at completion of fabrication stating that the panels and all components have been fabricated in all material respects in accordance with the DSA approved plans and specifications.

Exception: Continuous inspection is not required when plants are currently approved under the PCI Plant Certification Program.

3.4 All panels shall be marked with the approved inspector's identification mark, and a list of approved panels shall be provided to the project Inspector of Record (IOR) and DSA.

Exception: Panel identification by an approved inspector is not required when plants are currently approved under the PCI Plant Certification Program.

3.5 The testing program of premix products may be modified as it applies to specific panels.

3.6 All test reports shall be sent to the architect, structural engineer, IOR and DSA within five (5) working days of the completion of each test.

4. Specifications for GFRC Panels. Specifications should include the following:

1. GFRC panels shall be fabricated in accordance with the *PCI Recommended Practice for Glass Fiber Reinforced Concrete Panels*, 3rd Edition, as modified below. The manufacturer shall have an established quality control program that meets the requirements of the *PCI Manual for Quality Control for Plants and Production of Glass Fiber Reinforced Concrete Products*.
2. Requirements to provide corrosion protection for the stiffening frames, anchors, connectors and inserts.
3. Mix design requirements for the GFRC backing material. The cement/sand ratio shall not be less than 1:1 nor greater than 3:1
4. Requirement for glass fiber material. Only alkali resistant fiber may be used.
5. Bonding material for panel connectors.
6. Strength, strain and shrinkage requirements.
7. Requirement that the designs for in-service conditions be based on fully aged strength and strain properties.
8. Admixtures to be used. Admixtures containing calcium chloride shall not be used.
9. Description of the required testing procedures and apparatus.
10. Requirement for reporting test results to Architect, Structural Engineer, IOR and DSA.
11. Requirement for continuous fabrication inspection by an approved independent inspector, unless the plant is currently certified under the PCI Certification Program.

5. Drawings for GFRC Panels. Drawings for the GFRC panels should include the following:

1. Details for panel connectors; dimensions and thickness of bonding material; embedment dimension of panel anchors connectors in bonding material; dimension for weld length of anchor to steel stud framing.
2. Detail of enlarged or slotted hole to allow for erection tolerances and for sliding of panel, when floor to floor lateral drift is considered, without the yielding of rods. Drawings shall indicate the acceptable clearance between the connector rod and the sides of the hole, as determined by the design professional, to allow for movement without rod yielding.
3. For rectangular support tubes, indicate orientation.
4. Clearly identify the boundary and interface between GFRC Panel and supporting structural members on the design drawings.

6. Design for GFRC Panels by the Manufacturer's Engineer.

6.1 Check panel to structure connectors for buckling.

6.2 Check all structural members (tubes, angles, etc.) and connections to members that support GFRC panels and tie them to the structure.

6.3 Provide calculations for the design of the sub-frame to support the panels.

6.4 Provide calculations for the design of the GFRC panels for dead load, live load, wind load, earthquake load, the effects of creep, shrinkage and other moisture induced elements, and the effects of temperature change as applicable. Consider differences in the thermal and moisture induced strain properties of the facing and the backing.

7. Design Considerations for Project Design Engineer.

Check structural members and their connections for the torsional, vertical and lateral loads imposed by the GFRC panels.